

## INFLUENCE OF DIFFERENT COAGULATION TEMPERATURE AND COAGULANTS ON CHEMICAL AND SENSORY QUALITIES OF PANEER

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### ABSTRACT

*The present study was conducted with an aim to improve the textural attributes and yield of paneer. Different coagulation temperatures and different coagulants were employed. Pre treated milk for paneer preparation was coagulated at 65, 70 and 75°C, and the prepared paneer was subjected to sensory and chemical evaluation, which showed the paneer prepared by coagulating at 70°C had better overall acceptability and was found to contain 22.55, 18.67% fat and protein respectively and the yield was recorded 17.61%. The paneer milk optimized for coagulation temperature was added with two different coagulants citric acid and acetic acid, the best results were obtained for citric acid, which had 18.56% protein and 22.51% fat with maximum overall acceptability. The study shows the importance of coagulation temperature and coagulants on final quality of paneer.*

**KEYWORDS:** Acetic Acid, Citric Acid, Coagulation Temperature, Paneer

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### INTRODUCTION

Paneer is an indigenous milk product obtained by heat treatment of milk followed by coagulation with acids. Paneer preparation requires coagulation of milk protein to form curd from casein, during which there will be formation of large clumps of curd where fat and other solids will be entrapped. The coagulation temperature employed for acidification of milk directly affects the yield due to the predominant changes that occur in milk constituents fat, TS and moisture content. The body and texture characteristics are also significantly affected by the coagulation temperature. Heat treatment of milk results in destruction of microorganisms, and denatures the whey proteins and retards colloidal calcium phosphate solubility (Ghodekar 1989). Acidification brings about precipitation of casein micelles along with denatured whey proteins and insoluble calcium phosphate (Walstra and Jennes 1983). The type and the concentrations of coagulants used directly have effect on the sensory properties, moisture level and the yield of paneer. Various coagulants namely citric acid, acetic acid, lactic acid, malic acid, phosphoric acid, tartaric acid, mineral acids like hydrochloric acid and non-conventional coagulants like, lemon juice, sour whey and lactic cultures have been generally used (Kumar *et al.*, 1998).

In the present investigation, an attempt was made to study the effect of different coagulation temperatures and different coagulants on chemical and sensory qualities of panner.

## MATERIALS AND METHODS

**Milk:** Nandini brand milk samples from local market (Bengaluru) were procured for the preparation of paneer.

**Citric Acid:** Food grade citric acid supplied by Merck (India) Ltd, was used as a milk coagulant in the preparation of paneer.

**Acetic Acid:** Food grade acid supplied by Thomas Baker (Chemicals) Pvt. Ltd, was used as a milk coagulant in the preparation of paneer.

### Optimization of Paneer

The milk used for paneer preparation was first optimized for different levels of fat and heating temperatures by analyzing the prepared paneer samples with respect to sensory and chemical evaluation. Thus, optimized paneer with respect to fat and heating temperatures was added with coagulants at different temperatures (65, 70 and 75°C). At the best optimized coagulation temperature two different coagulants acetic acid and citric acid were added at 0.2% and was subjected for sensory and chemical evaluation.

### Preparation of Paneer

The milk used for paneer preparation optimized for 4.5% fat was heated in a stainless steel vessel to 90°C/no hold. This milk was cooled to various coagulation temperature followed by addition of hot solution of different coagulants with vigorous agitation initially and gentle stirring later till clear whey was separated out. Then the coagulum was allowed to settle down for 5 minutes. The separated whey was drained out using a muslin cloth and the curd was filled in to the hoop. It was subjected to pressing in a circular press at around 2kg/cm<sup>2</sup> for about 15-20 minutes. After pressing the product was transferred to vessel containing chilled water maintained at 4 °C for a period of 2 hours. The paneer prepared was cut into desired cubes for further analysis.

### Sensory Evaluation

Sensory evaluation of the paneer was carried out by a panel of 5 judges based on 9 point hedonic scale.

### Proximate Composition

The proximate composition of the paneer prepared by varying coagulation temperature, added with different coagulants was analyzed as per ISI: SP18 part XI (1981) for moisture, fat, protein, ash content and yield

### Statistical analysis

The data obtained in the study were analyzed using One way ANOVA using R software ( R. version 3.1.3).

## RESULTS AND DISCUSSIONS

### Effect of Different Coagulation Temperatures of Milk on the Chemical and Sensory Qualities of Paneer

#### Chemical Qualities

Coagulation of milk at different temperatures also decides the final quality of paneer. The influence of various coagulation temperatures adopted for milk on the resultant paneer was investigated and presented in Table 1.

The moisture content of treated sample T<sub>1</sub> was highest compared to other experimental samples and control sample. Increase in coagulation temperature decreases the moisture content in paneer (Sachdeva and Singh, 1988). The fat

content of control sample was 22.70% as against 22.50%, 22.55% and 22.58% for experimental samples T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. There was statistical difference between control and experimental samples. However, there was no significant difference found among experimental samples. It shows that the different coagulation temperatures had no significant effect on fat content of paneer. The Experimental sample T<sub>2</sub> had highest protein content of 18.56% compared to other treated samples and control sample. This could be due to at 70°C temperature the coagulation of casein is higher compared to coagulation at different temperatures. The highest ash content of 2.21% was observed for control sample. Treated samples T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> had ash content of 2.06%, 2.08 and 2.01% respectively. The results were statistically significant. Significant differences among experimental samples with respect to ash content may be depends on the moisture content of paneer.

Yield of paneer sample T<sub>2</sub> was 17.61% and this is highest among all the samples. It could be due to higher protein content and thereby higher total solids recovery in paneer at 70°C coagulation temperature

### **Sensory Qualities**

The impact of variation in coagulation temperature mainly occurs on body and texture paneer. The results pertaining to various coagulation temperatures on the sensory attributes of paneer are discussed below (table 2).

The sensory score for colour and appearance of control sample was 8.34 as against 8.30, 8.35 and 8.19 for experimental samples prepared by adopting coagulation temperatures of 65°C (T<sub>1</sub>), 70°C (T<sub>2</sub>) and 75°C (T<sub>3</sub>) respectively. Lower score for T<sub>3</sub> sample may be due to its dry appearance. The score for body and texture was highest for T<sub>2</sub> sample i.e. 8.00. Statistically it proved that significant difference exist between paneer samples. At higher temperatures of coagulation, extent of syneresis was more because of low viscosity of whey, making the curd harder. The control sample of paneer had sensory score of 8.26 with respect to flavour attribute. The treated samples T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> secured flavour scores of 8.23, 8.25 and 8.25. The scores obtained were statistically not significant indicating there was no significant effect of coagulation temperatures on flavour scores of paneer. The overall acceptability score for paneer sample T<sub>2</sub> was higher and it may be due to its bright colour and uniform appearance, chewy body and perfect close knit texture. Coagulation of milk at 70°C had the best organoleptic quality (Chandan, 2007).

### **Effect of Different Coagulants of Milk on the Chemical and Sensory Qualities of Paneer**

#### **Chemical Qualities**

The influence of various coagulants used in milk on the resultant paneer was investigated and the results are discussed below (table 3).

The moisture content of paneer prepared using acetic acid (T<sub>2</sub>) as a coagulant was 55.96% considered highest compared to moisture content (54.45%) of paneer made by using citric acid (T<sub>1</sub>) as coagulant. This could be due to milder effect acetic acid on milk protein resulted in milder level of denaturation of milk proteins thus retaining higher hydration capabilities compared to citric acid (Pal *et al.*, 1999). The fat content of control sample was 22.70% as against 22.51% and 22.02% for experimental samples T<sub>1</sub>, T<sub>2</sub> respectively. These results coincides with resulted obtained by Pal *et al.*, (2014). The highest protein content of 18.61% was recorded by control sample. While this value for experimental samples T<sub>1</sub> and T<sub>2</sub> was 18.56% and 18.00% respectively. There were statistical significant differences exist between the samples. This could be due to increase in the total solids content of the paneer which resulted in concomitant increase in the protein content in paneer. The ash content of 2.21%, 2.03% and 2.05% was observed for control sample, T<sub>1</sub> and T<sub>2</sub> respectively.

The results were statistically significant. However there were no significant differences in ash content of experimental samples which showing that there is no significant effect of coagulant type used on the ash content of paneer.

Yield of paneer made with citric acid was higher (17.65%) compared to paneer made from acetic acid as a coagulant. This could be due to higher protein thus, total solids recovery in paneer registered when citric acid used as coagulant compared acetic acid.

### Sensory Attributes of Paneer

Results pertaining to the effect of different coagulants used to coagulate milk on the sensory qualities of paneer are presented in table 4.

The colour and appearance score of control sample and paneer made using citric acid as the coagulant was same i.e. 8.32. This score for experimental sample prepared using acetic acid as coagulant was 8.35. The scores obtained were statistically non significant. It reveals that there was no significant effect of coagulant type on the colour and appearance scores of paneer. The maximum score obtained for body and texture was 7.79 for T<sub>1</sub> sample among the experimental samples. Control and T<sub>2</sub> samples secured 7.85 and 7.12 respectively. Statistical analysis showed the significant differences in body and texture scores of paneer made by different coagulants. The flavour score of 8.26 was obtained by control sample. Whereas experimental samples T<sub>1</sub> and T<sub>2</sub> got flavour score of 8.29 and 7.95 respectively. The least scores for T<sub>2</sub> may be due to slight pungent flavour. The maximum overall acceptability score of 8.29 was obtained by T<sub>2</sub> sample. Similar results observed by Pal *et al.*, 1999. This may be due to paneer prepared using citric acid had mild acidic flavour and firm body.

### CONCLUSIONS

The study reveals the importance of processing parameters and their effect on the quality and yield of paneer. Employing proper coagulation temperature and coagulants at definite rate will bring about significant changes on the textural and chemical attributes of paneer. Addition of coagulant citric acid at 70°C showed better sensory attributes and yield, which is an important parameter at industrial level.

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## APPENDICES

**Table 1: Effect of Different Coagulation Temperatures of Milk on the Chemical Qualities of Paneer**

	Parameters	Moisture	Fat	Protein	Ash	Yield
		(% )				
Paneer	Control	53.10	22.70	18.61	2.21	17.12
	T <sub>1</sub>	55.72	22.50	18.02	2.06	16.56
	T <sub>2</sub>	55.41	22.55	18.56	2.08	17.61
	T <sub>3</sub>	54.35	22.58	18.46	2.01	16.95
	CD(P≤0.05)	0.23	0.13	0.23	0.26	0.35

All the values are average of three trials

NS – Non-Significant

T<sub>1</sub> –Paneer – Coagulation temperature of milk-65°C

T<sub>2</sub> –Paneer – Coagulation temperature of milk-70°C

T<sub>3</sub> – Paneer – Coagulation temperature of milk-75°C

**Table 2: Effect of Different Coagulation Temperatures of Milk on the Sensory Qualities of Paneer**

Paneer	Sensory Attributes			
	Color and Appearance	Body and Consistency	Flavor	Overall Acceptability
Control	8.34	7.99	8.26	8.22
T <sub>1</sub>	8.30	6.83	8.23	7.42
T <sub>2</sub>	8.35	8.00	8.25	8.25
T <sub>3</sub>	8.19	7.81	8.25	8.12
CD(P≤0.05)	0.08	0.29	NS	0.25

All the values are average of three trials

NS – Non-Significant

T<sub>1</sub> –Paneer – Coagulation temperature of milk-65°C

T<sub>2</sub> –Paneer – Coagulation temperature of milk-70°C

T<sub>3</sub> – Paneer – Coagulation temperature of milk-75°C

**Table 3: Effect of Different Coagulants on the Chemical Quality of Paneer**

	Parameters	Moisture	Fat	Protein	Ash	Yield
		(% )				
Paneer	Control	53.10	22.70	18.61	2.21	17.12
	T <sub>1</sub>	55.45	22.51	18.56	2.03	17.65
	T <sub>2</sub>	55.96	22.02	18.00	2.05	16.95
	CD(P≤0.05)	0.26	0.14	0.16	0.25	0.33

All values are average of three trials

NS – Non-Significant

T<sub>1</sub> – Paneer – Coagulant used – Citric acid

T<sub>2</sub> – Paneer – Coagulant used – Acetic acid

**Table 4: Effect of Different Coagulants on the Sensory Qualities of Paneer**

Paneer	Sensory Attributes			
	Color and Appearance	Body and Consistency	Flavor	Overall acceptability
<b>Control</b>	8.32	7.85	8.26	8.23
<b>T<sub>1</sub></b>	8.32	7.79	8.29	8.29
<b>T<sub>2</sub></b>	8.35	7.12	8.01	7.95
<b>CD(P≤0.05)</b>	<b>NS</b>	<b>0.27</b>	<b>0.17</b>	<b>0.19</b>

All values are average of three trials

NS – Non-Significant

T<sub>1</sub> – Paneer – Coagulant used – Citric acid

T<sub>2</sub> – Paneer – Coagulant used – Acetic acid